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Ultralight Propellant Tank for Mars Exploration Rover Cruise Stage

by

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For extra-terrestrial space exploration, dry mass of propulsion components is critical. Lighter solutions are constantly being sought to maximize the mass available for scientific/technical payloads. For the Mars Exploration Rover (MER) cruise stage, ultralight propellant tanks were qualified to maximize scientific payload delivery to Mars. Two ultralight tanks for MER cruise stage were designed to provide 70 kg (155 lbs.) of hydrazine to the monopropellant system. Each tank consists of a thin aluminum liner overwrapped with polybenzoxyzole (PBO) fiber with a titanium, surface-tension-based propellant management device (PMD) for expulsion of the propellant. Each tank shell weighs approximately 1.4 kg (3 lbs.), which is only 4% of the propellant mass. This allows an 8.16 kg (18 lbs.) increase in scientific payload to the rover.

These ultrathin tanks are inherently damage sensitive and require special transport and handling procedures. However, the significant weight savings is worth the extra care when these ultralight tanks are chosen over more traditional metallic tanks.

The design of the ultralight tanks and the PMD device, flight qualification testing of the tank and PMD system, and damage control methods is discussed.